

## CLAIMS

What is claimed is:

1. A tool for electrochemical processing of microelectronic workpieces, comprising:
  - 5 a cabinet defining an interior enclosure;  
an electrochemical processing station comprising -
    - (a) a reaction vessel in the interior enclosure, the reaction vessel comprising a container and a plurality of separate electrodes in the container, and
    - (b) a head assembly having a workpiece holder configured to hold a  
10 microelectronic workpiece relative to the reaction vessel during a processing cycle; and  
a transfer device for handling workpieces in the cabinet, the transfer device having a robot comprising -
      - (a) an arm assembly including an arm that moves along a lift path and/or  
rotates about the lift path, and
      - 15 (c) at least a first end-effector carried by the arm, wherein the first end-effector rotates relative to the arm.
2. A tool for electrochemical processing of microelectronic workpieces, comprising:
  - a cabinet defining an interior enclosure;
  - 20 a first electrochemical processing station comprising -
    - (a) a first reaction vessel in the interior enclosure, the first reaction vessel comprising a first container and a plurality of separate first electrodes in the first container, and
    - (b) a first head assembly having a workpiece holder configured to hold a  
microelectronic workpiece relative to the first reaction vessel during a processing cycle;
    - 25 a second electrochemical processing station comprising -

(a) a second reaction vessel in the interior enclosure, the second reaction vessel comprising a second container and a plurality of separate second electrodes in the second container, and

(b) a second head assembly having a workpiece holder configured to hold a  
5 microelectronic workpiece relative to the second reaction vessel during a processing cycle;

a first power supply having a first electrical link coupled to the first electrodes in the first reaction vessel; and

a second power supply having a second electrical link coupled to the second electrodes in the second reaction vessel.

10 3. A tool for electrochemical processing of microelectronic workpieces, comprising:

a cabinet having a frame, at least one upper panel enclosing an upper compartment, and at least one lower panel enclosing a lower compartment, wherein the lower panel has an opening, and wherein the cabinet defines an interior enclosure;

15 a lift/rotate assembly having a housing rotatably coupled to an external portion of the frame to tilt outward relative to the frame, mechanical lift components in the housing, and a door coupled to the housing, wherein the door is received in the opening of the lower panel of the cabinet; and

an electrochemical processing station comprising -

20 (a) a reaction vessel in the interior enclosure, the reaction vessel comprising a container and at least one electrode in the container, and

(b) a head assembly carried by the lift/rotate assembly, the head assembly having a workpiece holder configured to hold a microelectronic workpiece relative to the reaction vessel during a processing cycle.

25 4. A tool for electrochemical processing of microelectronic workpieces, comprising:

a cabinet defining an interior enclosure;

an electrochemical processing station comprising -

(a) a reaction vessel in the interior enclosure, the reaction vessel comprising a container and a plurality of separate electrodes in the container, and

(b) a head assembly having a workpiece holder configured to hold a microelectronic workpiece relative to the reaction vessel during a processing cycle; and

5 a controller operatively coupled to the electrodes, wherein the controller is configured to provide a different electrical current to each of the electrodes of the reaction vessel.

5. A tool for electrochemical processing of microelectronic workpieces, comprising:

10 a cabinet defining an interior enclosure;

an electrochemical processing station comprising -

(a) a reaction vessel in the interior enclosure, the reaction vessel comprising a container, a plurality of electrode compartments in the container, and plurality of separate electrodes, wherein each electrode compartment contains a separate electrode, and

15 (b) a head assembly having a workpiece holder configured to hold a microelectronic workpiece relative to the reaction vessel during a processing cycle; and

a transfer device for handling workpieces in the cabinet, the transfer device having a robot comprising -

(a) an arm assembly including an arm that moves along a lift path and/or  
20 rotates about the lift path, and

(c) at least a first end-effector carried by the arm.

6. A tool for electrochemical processing of microelectronic workpieces, comprising:

a cabinet defining an interior enclosure;

25 a first electrochemical processing station comprising -

(a) a first reaction vessel in the interior enclosure, the first reaction vessel comprising a first container, a first field shaping unit in the first container, and a plurality of

separate first electrodes, wherein the first field shaping unit includes first electrode compartments that each contain one of the first electrodes, and

(b) a first head assembly having a workpiece holder configured to hold a microelectronic workpiece relative to the first field shaping unit during a processing cycle;

5 a second electrochemical processing station comprising -

(a) a second reaction vessel in the interior enclosure, the second reaction vessel comprising a second container, a second field shaping unit in the second container, and a plurality of separate second electrodes, wherein the second field shaping unit includes second electrode compartments that each contain one of the second electrodes, and

10 (b) a second head assembly having a workpiece holder configured to hold a microelectronic workpiece relative to the second field shaping unit during a processing cycle;

a first power supply having a first electrical link coupled to the first electrodes in the first reaction vessel; and

a second power supply having a second electrical link coupled to the second  
15 electrodes in the second reaction vessel separately from the first power supply.

7. A tool for electrochemical processing of microelectronic workpieces, comprising:

a cabinet defining an interior enclosure;

an electrochemical processing station comprising -

20 (a) a reaction vessel in the interior enclosure, the reaction vessel comprising a container and at least one electrode in the container, and

(b) a head assembly having a workpiece holder configured to hold a microelectronic workpiece relative to the reaction vessel during a processing cycle; and

a transfer device for handling workpieces in the cabinet, the transfer device having  
25 a robot comprising -

(a) an arm assembly including an arm that moves along a lift path and/or rotates about the lift path, and

(c) first and second end-effectors carried by the arm, wherein the first and second end-effectors rotate relative to the arm about at least one rotation axis generally parallel to the lift path.

8. A tool for electrochemical processing of microelectronic workpieces,  
5 comprising:

a cabinet defining an interior enclosure;

an electrochemical processing station comprising -

(a) a reaction vessel in the interior enclosure, the reaction vessel comprising a container and at least one electrode in the container, and

10 (b) a head assembly having a workpiece holder configured to hold a microelectronic workpiece relative to the reaction vessel during a processing cycle; and

a transfer device for handling workpieces in the cabinet, the transfer device having a robot comprising -

(a) an arm assembly including an arm that moves along a lift path and/or  
15 rotates about the lift path, and

(c) first and second end-effectors carried by the arm, wherein the first and second end-effectors rotate relative to the arm about at least one rotation axis generally parallel to the lift path, and wherein the first end-effector is spaced apart from the arm by a first distance to rotate through a first plane and the second end-effector is spaced apart from the arm by a  
20 second distance to rotate through a second plane separate from the first plane.

9. A tool for electrochemical processing of microelectronic workpieces,  
comprising:

a cabinet defining an interior enclosure;

an electrochemical processing station comprising -

25 (a) a reaction vessel in the interior enclosure, the reaction vessel comprising a container, a plurality of electrodes in separate electrode compartments in the container, and at least one interface member coupled to at least one of the electrode compartments between a corresponding electrode and a workpiece processing site, the interface member being configured

to prevent selected matter from passing from the electrode compartment containing the corresponding electrode to the workpiece processing site, and

(b) a head assembly having a workpiece holder configured to hold a microelectronic workpiece relative to the reaction vessel during a processing cycle; and

5 a transfer device for handling workpieces in the cabinet, the transfer device having a robot comprising -

(a) an arm assembly including an arm that moves along a lift path and/or rotates about the lift path, and

(c) at least a first end-effector carried by the arm.

10 10. A tool for electrochemical processing of microelectronic workpieces, comprising:

a cabinet defining an interior enclosure, the cabinet having a frame and panels attached to the frame to define the interior enclosure;

an electrochemical processing station comprising -

15 (a) a reaction vessel in the interior enclosure, the reaction vessel comprising a container and at least one electrode in the container, and

(b) a head assembly having a workpiece holder configured to hold a microelectronic workpiece relative to the reaction vessel during a processing cycle;

a transfer device for handling workpieces in the cabinet, the transfer device having  
20 a robot comprising -

(a) an arm assembly including an arm that moves along a lift path and/or rotates about the lift path, and

(b) first and second end-effectors carried by the arm, wherein the first and second end-effectors rotate relative to the arm; and

25 a lift/rotate assembly having a housing rotatably coupled to an external portion of the frame to tilt outward relative to the frame, mechanical lift components in the housing, and a door coupled to the housing, wherein the door is accessible to be opened without opening the cabinet.

11. A tool for electrochemical processing of microelectronic workpieces, comprising:

a cabinet defining an interior enclosure;

a transfer device for handling workpieces in the cabinet, the transfer device having

5 a robot comprising -

(a) an arm assembly including an arm that moves along a lift path and/or rotates about the lift path, and

(c) first and second end-effectors carried by the arm, wherein the first and second end-effectors rotate relative to the arm; and

10 a first electrochemical processing station comprising -

(a) a first reaction vessel in the interior enclosure, the first reaction vessel comprising a first container and a plurality of separate first electrodes in the first container, and

(b) a first head assembly having a workpiece holder configured to hold a microelectronic workpiece relative to the first reaction vessel during a processing cycle;

15 a second electrochemical processing station comprising -

(a) a second reaction vessel in the interior enclosure, the second reaction vessel comprising a second container and a plurality of separate second electrodes in the second container, and

(b) a second head assembly having a workpiece holder configured to hold a  
20 microelectronic workpiece relative to the second reaction vessel during a processing cycle;

a first power supply having a first electrical link coupled to the first electrodes in the first reaction vessel; and

a second power supply having a second electrical link coupled to the second electrodes in the second reaction vessel.